

STEP III, 2010 Q6 MS

6. P_1 is $(\cos \varphi, \sin \varphi, 0)$, P_2 is $(\cos \varphi \cos \lambda, \sin \varphi \cos \lambda, \sin \lambda)$, Q_1 is $(-\sin \varphi, \cos \varphi, 0)$, Q_2 is $(-\sin \varphi, \cos \varphi, 0)$, R_1 is $(0,0,1)$ and R_2 is $(-\cos \varphi \sin \lambda, -\sin \varphi \sin \lambda, \cos \lambda)$.

The scalar product $OP_2 \cdot OP_0$ gives the quoted result immediately. The direction of the axis can

be found from the vector product $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \times \begin{pmatrix} \cos \varphi \cos \lambda \\ \sin \varphi \cos \lambda \\ \sin \lambda \end{pmatrix}$ giving the direction of the axis as

$$\begin{pmatrix} 0 \\ -\sin \lambda \\ \sin \varphi \cos \lambda \end{pmatrix}.$$



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